

Lightning Climatology Product Description Document

7/16/2019

Part I - Mission Connection

- a) Product Description – Lightning climatology provides imagery through an online GIS-based web browser interface that users can access graphics on the climatologically-based frequency and amount of cloud-to-ground (CG) lightning for a given geographic area. The primary product output is a “heatmap” for both the relative frequency and total number of CG flashes for a given area.
- b) Purpose/Intended Use: This product is intended to provide users with a temporal breakdown of CG lightning flashes across a given geographic area. Potential high-end users of this data are but not limited to: organizers and/or supporters of outdoor events or activities, external partners and IMETs involved in fire weather and wildfire suppression activities,, and the aviation community. Additionally, the product output could inform visitors of U.S. National and State Parks and other outdoor venues on the climatological lightning frequency for those areas.
- c) Audience: The general public and internal NWS and external users who are interested in thunderstorm/lightning-based information.
- d) Presentation Format: The heatmaps imagery use Highcharts, a Javascript-based chart-generation software. Heatmaps can be accessed via a NOAA ArcGIS Online mobile-friendly web map application.
- e) Feedback Methods: Google Analytics will passively track usage of lightning imagery. Internal and external feedback will be solicited as well as a public survey will be distributed with the imagery.

Part 2 – Technical Description

- a) Format and Science Basis: Data. The imagery leverages raw Vaisala National Lightning Detection Network data, accessed from <https://www.ncdc.noaa.gov/data-access/severe-weather/lightning-products-and-services>. We stored around 900 million lightning flashes in a PostgreSQL database with PostGIS extension.

Visualization. One challenge to viewing lightning data in a useful way is the size of the dataset. Queries have been run ahead of time and the results have been stored, so the users are able to view the images immediately. Heatmaps were chosen to visualize the data because of its unique ability to summarize large datasets in one image and highlight hourly patterns throughout an entire year. Weekly X hour was chosen as the time interval instead of day X hour because lightning data can be quite noisy day-to-day for some areas of the country, and weekly organization of data is a way to offer smoother visualizations with easier pattern recognition. Two types of heatmaps are being offered--frequency and totals.

Frequency heatmap. This heatmap shows the percentage of years in the period of record (1988 - 2017 in current imagery) where at least one CG strike was observed, per hour, per week in a given year, for the selected geographic area. This provides the user a generalized probability (based on historical data) of at least one CG strike during a specific hour, for a specific week of the year.

Totals heatmap. This heatmap shows the total number of CG flashes observed, per hour, per week in a given year, for the selected geographic area. This provides the user information about when amount lightning activity that occurs in an average year.

Lightning detection efficiency. The user should be aware that lightning detection efficiency (DE) has increased throughout the past 30 years and the DE during 1988 is likely less than 2017 for most of the Continental US. Refer to this article for more details on the evolution of lightning DE.

<https://journals.ametsoc.org/doi/full/10.1175/MWR-D-16-0426.1>

Geographic area types. This version of the product provides CG strike frequency and totals imagery for counties and parishes, NWS fire weather zones, and 10-mile radius areas surrounding airports. The intent of this imagery is to provide an information about CG lightning frequency and totals data for a given geographic area but not lightning flash density. For the first two types of areas, if there are two geographic areas such as counties nearby each other with similar weather patterns, the smaller county will likely feature less total lightning flashes and have lower frequency of lightning flashes than the larger geographic area. In other words, the imagery is not normalized per unit area and comparison of frequency and totals imagery between two counties, fire weather zones, or other unique geographic areas will not be an identical comparison. The exception is the 10-mile airport radius imagery which all have identical spatial size ratios.

- b) Availability: The imagery, housed on the NWS Western Region webserver during evaluation stages, will be available to the public via a NOAA ArcGIS Online interface here:

<https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=1f94af1948914f4a8c4600cb427f2982&?mobileBreakPoint=250>

Weather Forecast Offices (WFOs) who share the map app with public and partners are encouraged to use URL parameters to control the extent of the map and zoom into their area of interest. For instance, the following URL zooms into Western Region when the map loads.

<https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=1f94af1948914f4a8c4600cb427f2982&extent=-125,31.9,-108.5,49&mobileBreakPoint=250>

Imagery can also be found directly on the Western Region webserver but requires some manual editing of the URL. An example is

<https://www.wrh.noaa.gov/mfr/lightning/heatmap/frequency/display.php?cwa=MFR&id=>

[Siskiyou&state=CA](#) where cwa is the County Warning Area, or Weather Forecast Office (WFO) 3-letter abbreviation, id is the county/parish name, and state is the 2-letter state abbreviation. In the case of airports, there is no state parameter needed, and id is the 3-letter airport abbreviation.

<https://www.wrh.noaa.gov/mfr/lightning/heatmap/frequency/display.php?cwa=&id=MFR&state=OR>

Esri ArcGIS Online:

Esri ArcGIS Online map information and photographic imagery are used under license by Esri. Esri ArcGIS Online map services are in the public domain and are also made available in open geospatial standard formats such as shapefile among other common formats from NOAA/NWS websites. The map information and photographic imagery contain trade names, trademarks, service marks, logos, domain names, and other distinctive brand features. This does not imply an endorsement of Esri ArcGIS Online mapping products or services by NOAA/National Weather Service. Under the terms of the license, you are permitted to copy or use the Esri ArcGIS Online images on your site so long as the Esri trade names, trademarks, service marks, logos, domain names, and other distinctive brand features are not deleted or in any manner altered.

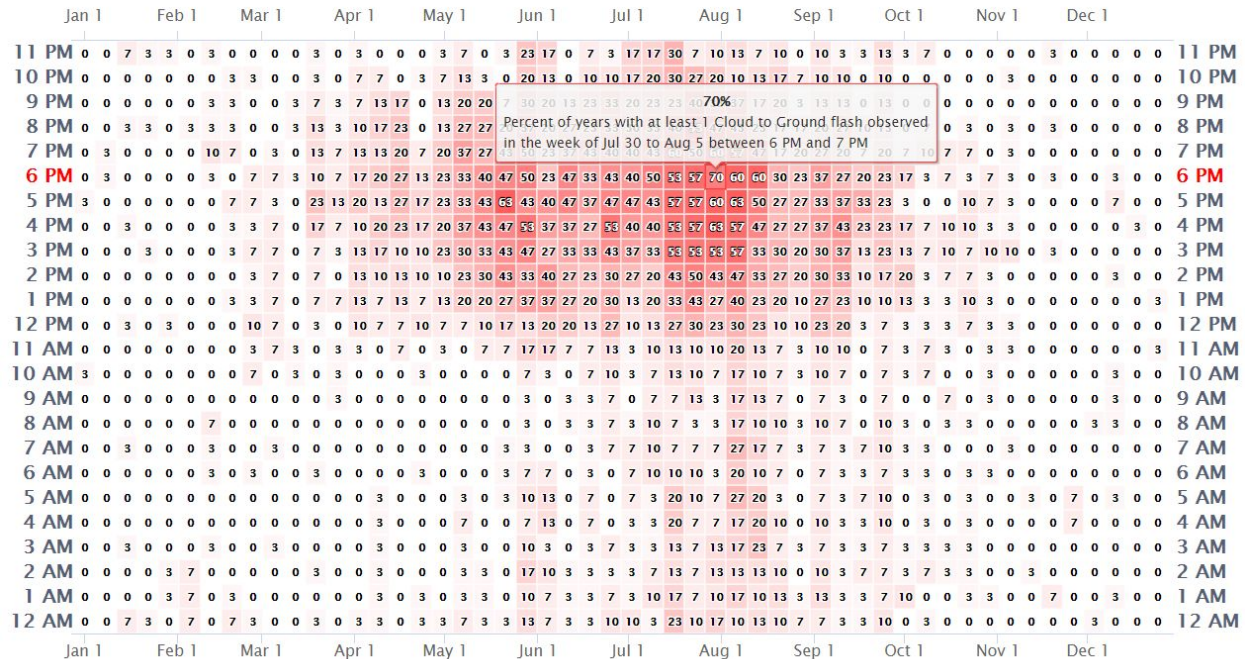
- c) Product Usability: A pop-up “splash screen” window will appear upon the initial viewing of the product webpage, through the NOAA ArcGIS Online interface. This window displays a YouTube hosted video, describing the product and demonstrating how to interact in this interface and display the information. There is also a brief written tutorial within this splash screen, where users can quickly attain information and example screen captures to aid in understanding of how to use the product.

Example heatmap of CG flash frequency for a selected area:



Siskiyou County CA Weekly by hour (Local Time) Frequency of Cloud to Ground Lightning Flashes 1988–2017

Note: This imagery is experimental and is in its evaluation stage



Data Source: Vaisala NLDN

Example heatmap of CG total (number of flashes) for a selected area:



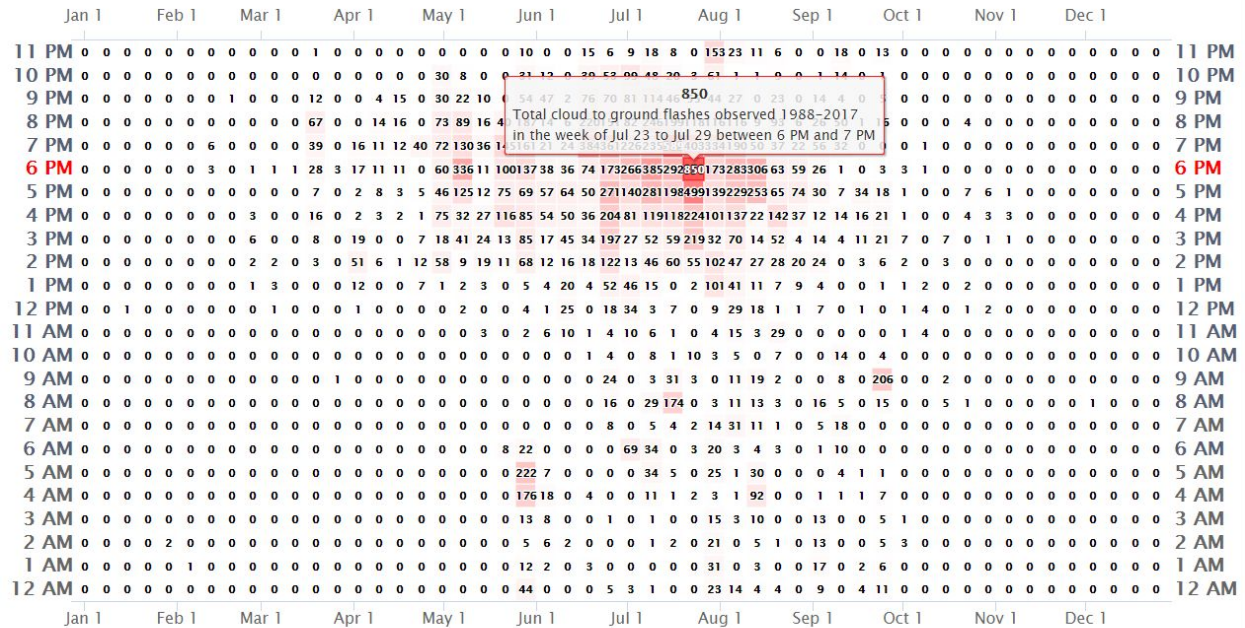
NATIONAL WEATHER SERVICE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



Fire Weather Zone 281 CA Weekly by hour (Local Time) Total Cloud to Ground Lightning Flashes 1988-2017

19.9K total flashes. The most flashes have occurred from Jul 23-Jul 29.
Note: This imagery is experimental and is in its evaluation stage



Total Observed Flashes 1988-2017



Data Source: Vaisala NLDN